

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 July 2004 (29.07.2004)

PCT

(10) International Publication Number
WO 2004/063410 A1

(51) International Patent Classification⁷: C22C 38/00,
C23C 2/40, C21D 9/46

(21) International Application Number:
PCT/JP2004/000239

(22) International Filing Date: 15 January 2004 (15.01.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2003-007087 15 January 2003 (15.01.2003) JP
2003-102488 7 April 2003 (07.04.2003) JP
2003-109328 14 April 2003 (14.04.2003) JP
2003-127123 2 May 2003 (02.05.2003) JP

(71) Applicant (for all designated States except US): NIPPON STEEL CORPORATION [JP/JP]; 6-3, Otemachi 2-chome, Chiyoda-ku, , Tokyo 1008071 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): TAKADA, Yoshihisa [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP). SUEHIRO,

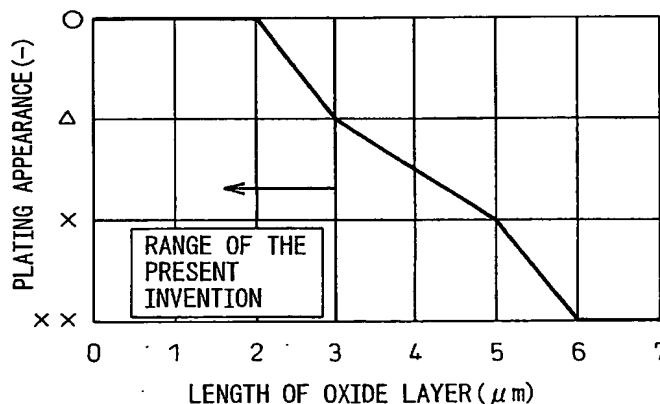
Masayoshi [JP/JP]; c/o NIPPON STEEL CORPORATION, Technical Development Bureau, 20-1, Shintomi, Futtsu-shi, , Chiba 2938511 (JP). KUROSAKI, Masao [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP). MURAKAMI, Hidekuni [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP). FUJII, Hiroyasu [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP). EGUCHI, Haruhiko [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP). SATO, Hisaaki [JP/JP]; c/o NIPPON STEEL CORPORATION, YAWATA WORKS, 1-1, Tobihata-cho, Tobata-ku, Kitakyushu-shi, , Fukuoka 8048501 (JP).

(74) Agents: AOKI, Atsushi et al.; A. AOKI, ISHIDA & ASSOCIATES, Toranomom 37 Mori Bldg., 5-1, Toranomom 3-chome, Minato-ku, Tokyo 1058423 (JP).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,

[Continued on next page]

(54) Title: HIGH-STRENGTH HOT-DIP GALVANIZED STEEL SHEET AND METHOD FOR PRODUCING THE SAME



(57) Abstract: The present invention stably provides a high-strength hot-dip galvanized steel sheet having a high tensile strength and no non-plated portions and being excellent in workability and surface properties even when the employed equipment has only a reduction annealing furnace and a steel sheet containing relatively large amounts of Si, Mn and Al that are regarded as likely to cause non-plated portions is used as the substrate. The present invention: secures good plating performance even when the steel sheet contains Si, Mn and Al by adding Ni to a steel sheet, thus forming oxides at some portions in the steel sheet surface layer, and resultantly suppressing the surface incrustation of Si, Mn and Al at the portions where oxides are not formed; enhances the effect of Ni and accelerates the formation of oxides by further adding Mo, Cu and Sn; and moreover, in the case of a TRIP steel sheet, secures austenite by determining the ranges of Si and Al strictly, avoiding the deterioration of plating performance caused by the addition of Ni, and further adding Mo in a balanced manner. In addition, the present invention, in a TRIP steel sheet, improves press formability by regulating a retained austenite ratio and accelerates the formation of oxides by regulating a hydrogen concentration and a dew point in annealing before plating.



CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.